PUNCTURED FRACTURE OF THE SKULL.*

BY GEORGE G. ROSS, M.D.,
OF PHILADELPHIA, PA.
Assistant Surgeon to the German Hospital; Surgeon to the Germantown Hospital.

THE case herewith reported, as the basis of this paper, is unusual in many ways. It offered diagnostic difficulties which were completely solved only at the post mortem table, and has many points of interest, clinically, pathologically and in a legal way.

ADOLPH H. Age 21.—On October 4, 1906, patient was seen by Dr. L. Demme Bauer. He gave a history of having been struck about the right eye with an umbrella, five days previously, on September 30th. The patient complained of a great deal of pain over the right temporal region, and of general malaise. He was entirely rational and answered questions intelligently. Physical examination showed that the right eye was the seat of a conjunctivitis, and the eyelids were puffy. There was no discoloration, ecchymosis or external evidence of any abrasion, in or about the eye. Both eyes reacted normally to light and accommodation, and the pupils were equal. The tongue protruded in the median line, and the naso-labial fold on either side unaffected. The temperature was 102° F., pulse 90, respiration 18. In spite of the fever there was an unusual coldness of the body. A boric acid lotion was ordered for the eye.

On October 5, 1906, the patient was again seen. His mental condition was still good, but the malaise was more marked. There was no paralysis of the extremities. The temperature was 102°. He was removed to the German Hospital in the afternoon.

Patient is a well-nourished and well-developed German lad. He is in a stuporous condition, and answers questions slowly and incoherently. He lies upon his back, with his eyelids closed, and desires not to be disturbed, but occasionally tosses his head from side to side. He complains of chilliness, and a great deal of tenderness over the right temporal region. There was no evidence of alcoholism or uremia.

---

* Read before the Philadelphia Academy of Surgery, October 1, 1907.

The head was carefully examined, and no evidence of fracture was detected. There were no cuts or bruises on the scalp. There was no discharge from the nares or from either external auditory meatus. There was no œdema over either mastoid. The tongue was protruded in the median line, without tremor. There was no facial paralysis. There was no cyanosis of visible mucous membrane on the lips, or of the finger tips. The right eye showed slight injection of the bulbar conjunctiva, but there was no evidence of injury to the eye. Both eyes reacted normally to light and accommodation and there was no irregularity of the pupils. The sclera was not icteroid.

The chest, heart and lungs were negative. The pulse was slow and regular. The abdomen was negative. The patient having been sent in with a suspicion of enteric fever, was examined very carefully for enlarged spleen and spots, and for a history of nose bleed, all of which were negative. The extremities could all be moved. The superficial and deep reflexes so far as examined were unaffected. Temperature, 99 2-5°; pulse, 64; respiration, 22.

A catherized specimen of urine, 570 c.c., had a reddish-yellow color, acid reaction, specific gravity 1038, faint trace of albumin and many amorphous urates, but no tube casts.

At 12 o'clock midnight, October 5, 1906, the temperature was 102 2-5°, respiration 24, pulse 64. During the night the patient was very restless, talking constantly and complaining of a great deal of pain in the head. He passed 1060 c.c. (35 ounces) of urine during the first twenty-four hours in the hospital. October 6, 1906. Leucocyte count 15,900.

October 7, 1906. About 10 A.M. it was noticed that the right pupil was more widely dilated than the left but still reacted to light and accommodation. No evidences of paralysis were yet found, but a tentative diagnosis of cerebral pressure was made, the possible causes considered being either depressed fracture, a clot from rupture of some portion of the meningeal artery or its branches, or a collection of pus. The diagnosis of cerebral abscess was suggested by the intermittent temperature, leucocytosis, and the chilly feeling of the patient.

The X-ray of the skull showed a shadow which was interpreted as a fissured fracture of the vertical plate of the frontal. This opinion was not positive. The patient grew worse, and on the night of October 7th, became very delirious, and tried to get out of bed. Morphia $\frac{1}{8}$ gr. was given and quieted the patient.

October 8, 1906. Patient had become quite comatose and the right pupil was widely dilated. There was no paralysis of either arm or leg. The patient's condition in other ways was as twenty-four hours before.

An eye examination was made by Dr. Wm. T. Shoemaker. O.D. and O.S. react to light and accommodation. O.D., dilated pupil. O.S., normal pupil. Ophthalmic examination. O.D. shows slight obscuration of disc. No hemorrhage into retina.

Soon after this examination was made it was noted, that while the patient was moving his right arm and leg, the left arm and leg were limp by his side. One hour before this, however, the resident physician saw the patient move his left arm and leg, and a patient in the adjoining bed saw him attempt to get out of bed, using his left arm and leg in doing so. An examination showed a complete left-sided hemiplegia. The indications of intracranial pressure were now unmistakable, and operation for relief was decided upon and performed about 5 P.M., October 8th.

Operation.—October 8, 1907. Ether anæsthesia. A curved incision, with its center over the most prominent part of the parietal eminence, was made. It started some distance behind the right ear, and was carried upward and forward. The tissues were divided down to the bone. A one-inch trephine opening was made over the most prominent part of the parietal eminence, and was enlarged with a rongeur forceps. The dura bulged into the wound. It was opaque, non-pulsatile, and dark underneath. The dura was incised, and a large abscess of 150 to 200 c.c. of dark, foul-smelling pus evacuated. The brain then came down into the opening and pulsation became evident. The abscess cavity was carefully and thoroughly wiped out with gauze sponges.

Three pieces of iodoform gauze were placed in the abscess cavity for drainage, the ends being brought out of the opening. The skin wound was closed with interrupted sutures of silk-worm gut, room being left for gauze drainage to come out. An antiseptic dressing was applied.

After coming out of the ether the patient was semi-conscious, could be aroused with little difficulty, and had periods of restlessness alternating with stupor. Such was his condition all of the

Fig. 1.

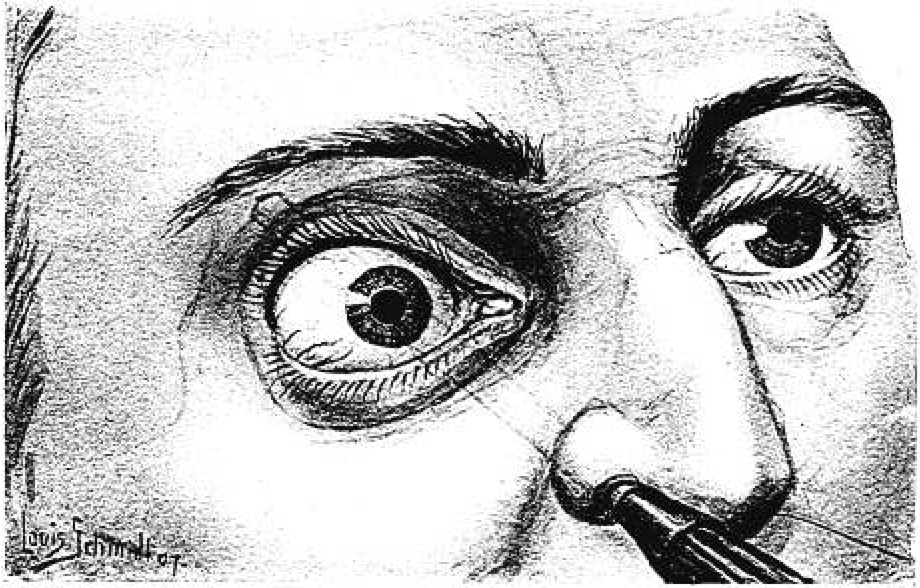
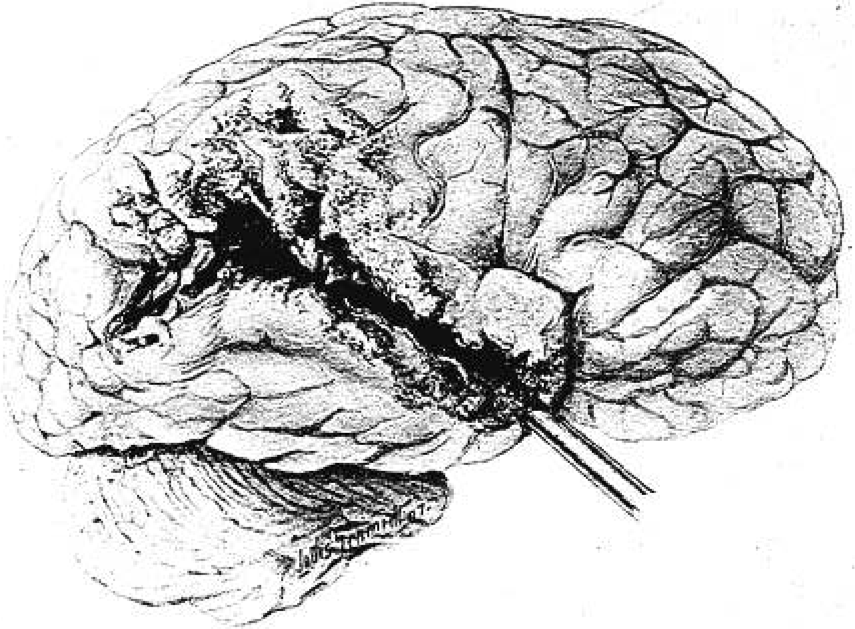


Fig 2



next day, October 10th. The right pupil was dilated and did not respond to light. The left side still paralyzed. The outer dressing was changed and the wound was found to be discharging freely.

October 10th. In the morning the patient was improved. He answered questions in a fairly rational way; his pupils were equal and reacted to light and the paralysis of the left arm was not so profound.

At 10.25 A.M. the patient suddenly stopped breathing and became deeply cyanosed. The pulse remained full and strong for two to three minutes after breathing ceased. Artificial respiration was performed without avail and the pulse gradually weakened and stopped.

Post-Mortem Examination.—The face and head presented no external evidences of injury. There was no ecchymosis or swelling about the eyes or forehead.

The skull cap was removed and the brain exposed. A large abscess cavity, about the size of a large orange, was found in the right temporo-sphenoidal lobe. An investigation of the middle fossa showed a fracture of the greater wing of the sphenoid, a little below and to the outer side of the outer end of the sphenoidal fissure. Several loose spicules of bone were removed and the fracture opening was found to be nearly circular. The right eye was removed, exposing the floor of the orbit. A fissured fracture, with a loose fragment of the bone, was found opening the roof of the antrum of Highmore. The antrum was full of pus, and showed a fracture of the inner wall into the nose. The line of penetration was then from before backward, from nose to antrum, antrum to orbital cavity, and thence to the middle fossa of the skull, thus furnishing an avenue of infection direct from the nasal cavity to the temporo-sphenoidal lobe of the brain. A straight probe could be made to traverse the entire tract without obstruction.

The instrument of penetration had traversed the fatty bed of the eyeball and had not infringed upon or in any way injured the eyeball, its vessels or nerves, thus accounting for the lack of ecchymosis or permanent swelling. (Figs. 1 and 2.)

A septic embolus having the appearance of a chicken fat clot, and about the size of a small bean, was discovered in the floor of the fourth ventricle. This explains the sudden death from respiratory failure. There was no evidence of any intracranial hemorrhage, either extradural or subdural. The inner wall of the mastoid cells seemed normal and intact. The rest of the body was normal in every respect.

In looking over the literature of Punctured Fractures of the Skull I have failed to find a similar case. The vast majority of punctured fractures of the skull are, as would be expected, the result of bullet wounds received in battle, and come under the hands of military surgeons. The majority of these cases are instantly fatal or live so short a time that secondary results do not supervene. This is particularly true of wounds caused by the modern high velocity bullets, the injury to the brain in these cases being highly destructive. In civil life the wounds are caused generally by other instruments or by low velocity fire-arms. Here the skull offers enough resistance to take up most of the energy, with the consequent low grade of injury to the intracranial organs, and hence these cases often survive the injury long enough to permit of the development of hæmorrhage and infection. These are the two great dangers of punctured fractures in those cases which do not succumb at once. The hæmorrhage is most often subdural. The infection may involve the cerebrum, the meninges or both, and any portion of the brain may be the seat of an abscess.

In a series of 316 cases of foreign bodies in the brain analyzed by Dr. Henry Wharton in 1879[1] a number of cases of punctures by objects other than bullets are recorded. Gunshot wounds of the skull and brain I have not attempted to include in this summary of the literature. In Dr. Wharton's series there were stab wounds by swords and bayonets, and wounds caused by the ferrules of canes and umbrellas. Five cases of penetration of the sphenoid bone are recorded, and 18 of wounds of the orbit.

Since that time numerous cases have been reported.

Brown and Birch,[9] Ferguson,[10] Lemonnier,[28] Fisher,[11] H. M. Holmes,[13] Mac Kellar,[16] Wilson,[18] Beckwith,[19] Taylor,[20] D'Cruz,[22] Schmid,[24] Odell,[25] Batut,[28] and Kennedy,[29] have reported cases of simple puncture of the skull, not followed by abscess.

Felty,[2] Rehm,[5] Glasgow,[33] Mandel,[23] and P. Ross,[21] have reported punctured fractures of the skull followed by cerebral abscess.

Griffith[30] has reported a case of cerebellar abscess following puncture of the skull and brain.

Dutra,[6] Laplace,[7] A. S. Holmes,[12] Jewett,[14] Lusk,[15] Prideau,[17] and Grekoff,[27] have reported punctured fractures through the orbit with brain injury but not followed by infection, while Builer,[8] and Lee,[4] reported similar injuries followed by abscess and meningitis.

Randall has reported a case (quoted by Spiller) of perforation of the ethmoid through the nose by the rib of an umbrella, with secondary cerebral abscess. I reported a case to this academy last year, of a puncture of the vertex of the skull in which the superior longitudinal sinus was opened. The case recovered, and there was no infection. I also know of another case in which the olfactory plate of the frontal was perforated by the rib of an umbrella which entered the nose. This case was fatal.

In practically all of these cases the diagnosis of the primary and secondary conditions was made easy by a knowledge of the injury and local evidences of trauma. In the case here reported, however, we did not have these facts to guide us. The history, in itself meagre, was misleading, as no indication of an injury to the nares was present on superficial examination. The diagnosis of a cerebral abscess could not be made with certainty. At best the recognition of this condition is a matter of difficulty.

There is no symptom or combination of symptoms pathognomonic of brain abscess, therefore in the absence of a recognized fracture, middle ear infection or suppuration elsewhere in the body, its diagnosis must be doubtful.

Spiller, Penn. Med. Journ., Oct., 1906, P. 30, says: "The diagnosis of cerebral abscess depends chiefly upon the signs of some more or less rapidly developing lesion of the brain, with the discovery of a purulent process somewhere else in the body or of a wound of the head." Note the qualifying clause.

Von Bergman states that marked symptoms of localization, provided they are accompanied by headache and fever, constitute the most important signs of cerebral abscess. He also lays great stress upon the condition of the skull wound, when one is present, and upon the flow of the pus from the fissure in the skull or from between the fragments of a comminuted fracture.

Leucocytosis of course may aid us in the diagnosis of abscess, as may also at times the presence of choked disc—not found, however, in the case I here report. The main features upon which we had to form our opinion in this case were:

1. Pain in the right temporal region. 2. Tenderness in the right temporal region. 3. Leucocytosis. 4. A persistent feeling of cold. 5. The intermittent temperature. 6. Persistent slow pulse.

The factors which operated against the establishment of a positive diagnosis were: 1. Existence of fracture without external evidence of injury. 2. Delay of paralysis until the abscess was large enough to cause pressure on the motor area. 3. Absence of choked disc.

The diagnosis was not made definitely and this is not surprising in view of the facts. The operation was undertaken primarily for the relief of intracranial pressure.

Granting that the existence of an abscess or of other serious intracranial complications can be established, operation is of course indicated, and indeed operation offers us a better chance in punctured fracture of the skull when the signs of intracranial lesion are not well marked, or even absent. In making this statement, I am taking into consideration the great mortality in fractures of this kind especially when they traverse the orbit. In Dr. Wharton's series, 17 of the 18 cases of orbital penetration died, although it is stated by him that "in many cases the persons were unconscious of the injury and the unfavorable symptoms developed suddenly."

Therefore it is a wise procedure to open the skull at the wound of entrance at the earliest possible moment after the accident, irrespective of symptoms or lack of symptoms. The fatality of brain abscess or septic meningitis is so great that any procedure looking toward prevention is imperative. When as in this case, the history of the injury is vague and no wound of entrance can be found, the indications for early operation are not so positive.

In conclusion, I would call attention to the wisdom of nose examination in any case of traumatism about the head when the history is at all doubtful or undetermined.

REFERENCES.

[1] Phila. Med. Times, July 19, 1879.
[2] Med. News Phila., 1894 lxv 710.
[3] Greifswald University Clinic Rep., 1889-90.
[4] Hoemeop. Eye, Ear and Throat Journ., 1897.
[5] Aerztlichs Int. Blatt. Munich, 1881, xxviii, 451.
[6] Brazil Med. Rec., Jan. 1890, v, 109.
[7] Med. News Philada., 1891, lix, 657.
[8] Arch. de Med. et Pharm., Paris, xviii, 63.
[9] Philada. County Med., 1889, x, 395-415.
[10] N. Y. Med. Journ., 1896, lxiv, 360.
[11] Deutsche Zeitschr fur Chir. 1882-3, xviii 411-13.
[12] Med. Herald Louisville 1882-3, ii, 482.
[13] Trans. S. Car. Med. Assc. 1882, xxxii, 111.
[14] N. Car Med. Journ., 1893, xxxi, 91.
[15] Trans. N. J. Med. Assc., 1893, x, 395-400.
[16] Lancet London, 1886, ii, 846.
[17] Lancet London, 1886, ii, 846.
[18] Brit. Med. Journal, 1887, i, 278.
[19] Gaillard's Med. Journ. N. Y., 1882, xxxv, 120.
[20] International Med. Mag., 1898, viii, 87-101.
[21] Brit. Guian Med. Annal., 1897, p. xxix.
[22] Ind. Med. Rec. Calcutta, 1900, xix, 160.
[23] Med. Rec. N. Y., 1900, lviii, 435.
[24] Med. Corresp. Blatt fur Wurttenberg Aerzte, 1900.
[25] Brit. Med. Journ., 1900, i, 700.
[26] Annals Med. Med. De Caen., 1902.
[27] A Russian Med. Journal, 1903.
[28] Bull Soc. Med. et Chir. de la Drone, 1904.
[29] Glasgow Med. Journ., 1905, lxiii, 394.
[30] Scot. Med. & Surg. Journ. Edinburgh, 1905, xvi, 412.
[31] Academy of Surgery Transactions, 1906.
[32] Quoted by Spiller, Penn. State Med. Journ., Oct., 1906.
[33] St. Louis Courier. Med., 1884, xi, 75.